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Fabrication and characterization of high temperature ceramics for novel solar absorbers

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Abstract

The best candidate materials for the novel solar absorber should possess a combination of properties including appropriate absorbance, good electrical conductivity and resistance to oxidation in air.

Porous SiC and dense SiC were rejected for several reasons. Porous SiC has a proper absorbance but no electrical conductivity and poor mechanical strength. Dense SiC has modest absorbance and poor electrical conductivity.

The multiphase composites, SiC-$MoSi_2$, AlN-SiC-$MoSi_2$ have a better combination of properties, that can be tailored through compositional rearrangement of the constituent phases. Moreover, they have a superior oxidation resistance thanks to the development of a silica-based protective layer. HfC-$MoSi_2$ have a good absorbance, but too high reflectance and poor resistance to oxidation.

Results of the optical properties measurements suggest to reduce the amount of secondary phases such as $MoSi_2$, basically for two reasons:

- as $MoSi_2$ behaves like a sintering aid, reduction of its volumetric content hinders complete elimination of porosity during sintering. Residual porosity seems to increase the material's absorbance.
- $MoSi_2$ can increase the material's reflectance, especially for matrices such as SiC and AlN.

On this basis, the activity has concentrated on the design of optimized compositions with a lower content of $MoSi_2$.

On selected compositions, long oxidation tests have been performed in order to verify the capability of the material to withstand 1100°C for 100 hours.